4.8.9 AG9 - COLORADO RIVER

The Colorado River Region includes a large area of the state's southeastern corner, with about 650,000 acres of irrigated land. The region mainly includes the agriculturally rich Coachella and Imperial Valleys. The Salton Sea, located between the two valleys, is a prominent feature of this area.

AGRICULTURAL INFORMATION
Colorado River Region

Types of crops grown:	Row crops such as cotton, grain, sugar beets, corn, alfalfa, and other truck crops. Alfalfa constitutes about 34% of irrigated acreage. About 7% of irrigated land (50,000 acres) is vineyard and citrus.
Irrigated land:	Approximately 650,000 acres (plus 100,000 acres double cropped).
Types of irrigation systems in use:	The majority of the area is under surface irrigation (furrow). Sprinkler and drip/micro systems are more prevalent on trees and vines but are increasingly used on row and truck crops (such as melons).
Average applied water:	Approximately 2.8 MAF annually.
Source of water:	Groundwater, including an overdraft of approximately 75 TAF annually (although not all attributable to agriculture). The resort areas in the Coachella Valley also use a significant amount of groundwater resources. Surface water is delivered from the Colorado River via the All American Canal. A small amount of SWP water also is delivered to the Coachella Valley via an agreement that exchanges Colorado River water for Delta export water. Reuse of losses is an important feature and is increasing through the adoption of on-farm tailwater recovery systems and district-wide improvements, especially in the Imperial Valley.

The Sea currently is fed by rainfall from the surrounding desert mountains and by agricultural surface drainage from the two valleys. Rainfall in the mountains also recharges the groundwater aquifers that underlie the region. Because of constant evaporation, coupled with the rainfall runoff and agricultural drainage that contain naturally occurring salts, the salinity of the Salton Sea continues to increase. It is now more saline than the Pacific Ocean. However, agricultural drainage also is considered to play a vital role in supplying relatively fresh water supplies to the Sea to maintain water levels and dilute salinity and other toxicities that flow to the Sea from other sources. By 2020, an estimated 10 TAF of water may be needed annually to maintain a stable water level in the Salton Sea. Efforts to reduce the agricultural losses that flow to the Sea must consider this fact. Several plans to conserve water in the area while stabilizing the Sea's salinity and water levels have been developed by the Salton Sea Task Force, chaired by the State Resources Agency. However, these plans would incur substantial cost (DWR 1994).

Because the source of water used in this region originates in the Colorado River and not the Delta, conservation of losses not deemed irrecoverable have little value to the Bay-Delta (if it is not an irrecoverable loss that can be reallocated, there is no water quality or ecosystem benefits that can be transferred to the Bay-Delta).

Colorado River Region

Table 4-14a. Total Potential Reduction of Application (TAF)

USE	TOTAL EXISTING LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	59-90	44-67	103-157
District	-	42-64	31-48	73-112
Total	**635**	**101-154**	**75-116**	**176-270**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-14b. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-14a)

USE	TOTAL IRRECOVERED LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	42-74	32-55	74-129
District	-	30-52	22-39	53-91
Total	**565**	**73-126**	**54-95**	**127-221**

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-14c. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-14a)

USE	EXISTING RECOVERED LOSS	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
On farm	-	16	12	28
District	-	12	9	21
Total	**70**	**28**	**21**	**49**

[1] See regional table in Attachment A at the end of this document for derivation of values.

Special Conditions

The Imperial Valley and most of the Coachella Valley may play a limited role in a CALFED Bay-Delta solution. Since water used in this area is primarily imported from the Colorado River, reduction in losses will not directly affect the Bay-Delta watershed. However, the potential exists to transfer reductions in irrecoverable losses to offset existing or future demands of southern California, a primary exporter of Bay-Delta waters. To the extent that offsetting can occur, a benefit may be realized in the Bay-Delta watershed. If this conserved water is transferred to southern California, but not in a manner to reduce existing or future Bay-Delta exports, no benefit can be claimed by the CALFED Program. This is the most probable outcome, since California already diverts more than its allocation of Colorado River water entitlement.

Efforts by other states with entitlement to Colorado River water, including Arizona, Colorado, and Utah, may soon force California to reduce its total diversion from the Colorado River. Today, agriculture uses about 3.8 MAF annually of Colorado River water. Urban uses, delivered to southern California via the Colorado Aqueduct, account for an additional 1.3 MAF. California's entitlement is only 4.4 MAF annually, approximately 800 TAF less than existing diversions. The urban demands of southern California met by the Colorado River, delivered via the Colorado Aqueduct, most likely would remain at the levels seen today, or 1.3 MAF. Therefore, reduction probably would occur through reducing agriculture's use of California's entitlement in order to reach the 4.4-MAF limitation.

This process already has begun, with near completion of the MWD's transfer agreement with Imperial Irrigation District. This landmark agreement will result in just over 100 TAF being transferred annually from agricultural uses in the Imperial Valley to urban uses in southern California. The water is generated through conservation and efficiency improvements. The transferred quantity will be conveyed via the existing Colorado Aqueduct, which already runs at capacity. In essence, this is a method of reducing California's overall use of Colorado River water to its required entitlement but maintaining full use of the Colorado Aqueduct to deliver water to urban areas.

Recently, discussions between the Imperial Irrigation District and San Diego have proposed another agricultural-to-urban water transfer. This agreement potentially will transfer another 200 TAF to southern California. The water would be derived from on-farm conservation. If this transfer occurs with no resulting reduction in San Diego's Bay-Delta supplies, there will be no benefit to the Bay-Delta system from the Colorado River Region. Given that the total irrecoverable loss estimate is no greater than the proposed San Diego/Imperial Irrigation District transfer, there probably would be no further opportunities to benefit the Bay-Delta via water conservation in the Colorado River Region after the San Diego transfer is realized.

4.9 SUMMARY OF ESTIMATED AGRICULTURAL CONSERVATION POTENTIAL

Tables 4-15, 4-16, and 4-17 summarize the regional conservation estimates for agricultural conservation potential.

Although the total potential reduction associated with irrecoverable losses could amount to as much as 540 TAF, it must be recognized that this amount would require all farms to be irrigated at very high efficiency and would require regions to substantially improve delivery systems. Achieving this would require significant local, state, and federal support.

It also should be noted that the additional potential irrecoverable loss reduction resulting from the Water Use Efficiency Program is less than half of the total shown (233 of 540 TAF). This demonstrates CALFED's assumption that existing trends will continue to provide improved efficiency regardless of the outcome of the CALFED Program. In addition, a significant portion of the irrecoverable loss reduction is in the Colorado River Region, which may or may not provide any Bay-Delta benefit.

Much of the reduction in existing loss estimated in Table 4-15 is composed of recoverable losses (as shown in Table 4-17) and is not available for reallocation for other water supply purposes. However, this significant conservation potential can provide valuable water quality, water management, and ecosystem benefits that are also key objectives of the CALFED Program. In addition, reducing these losses may provide in-basin water management benefits and help reduce future demand projections.

Table 4-15. Total Potential Reduction of Application (TAF)

REGION	TOTAL EXISTING LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
Sacramento	2,182	766-819	574-614	1,340-1,434
Delta	358	124-134	93-100	217-234
Westside San Joaquin River	388	124-137	93-103	217-241
Eastside San Joaquin River	1,262	436-471	327-353	764-824
Tulare Lake	2,315	708-795	531-596	1,239-1,391
San Francisco Bay	23	7-8	5-6	12-14
Central Coast	10	3-4	2-3	5-7
South Coast	213	56-67	42-50	97-117
Colorado River	635	101-154	75-116	176-270
Total	**7,386**	**2,325-2,589**	**1,742-1,941**	**4,067-4,532**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow. Only the portion of these losses that is defined "irrecoverable" is available for reallocation to other beneficial water supply purposes.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-16. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-15)

REGION	EXISTING IRRECOVERED LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
Sacramento	225	0-36	0-27	0-63
Delta	22	0	0	0
Westside San Joaquin River	68	0-9	0-7	0-16
Eastside San Joaquin River	104	0-7	0-6	0-13
Tulare Lake	602	23-110	17-82	40-192
San Francisco Bay	12	2-3	2-3	4-6
Central Coast	1	0	0	0
South Coast	123	20-31	15-23	35-54
Colorado River	565	73-126	54-95	127-221
Total	**1,722**	**118-322**	**88-243**	**206-565**

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-17. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-15)

REGION	EXISTING RECOVERABLE LOSS	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
Sacramento	1,957	766-783	574-587	1,340-1,370
Delta	336	124-134	93-100	217-234
Westside San Joaquin River	320	124-128	93-96	217-224
Eastside San Joaquin River	1,158	436-463	327-347	763-810
Tulare Lake	1,713	685	514	1,199
San Francisco Bay	11	4	3	7
Central Coast	9	3-4	2-3	5-7
South Coast	90	36	27	63
Colorado River	70	28	21	49
Total	**5,664**	**2,206-2,265**	**1,654-1,698**	**3,860-3,963**

[1] See regional table in Attachment A at the end of this document for derivation of values.

4.10 ESTIMATED COST OF EFFICIENCY IMPROVEMENTS

Reducing recoverable and irrecoverable losses through improved efficiency will result in additional district operation costs as well as on-farm production costs. These increases originate from irrigation system upgrades, changes in management style, and increased operation and maintenance. When cost-effective conservation measures are implemented, costs are incurred regardless of who pays or who benefits. Estimated costs presented in this document do not attempt to allocate the costs or determine whether implementation is cost effective. Determination of the cost effectiveness of various efficiency measures will not be estimated for purposes of the programmatic EIS/EIR, but will occur on a case-by-case basis during implementation phases. This information is provided to give a sense of the funding necessary to achieve higher levels of water use efficiency.

4.10.1 COST OF REDUCING APPLIED WATER VS. COST OF REAL WATER SAVINGS

Implementation of specific water delivery improvements, whether on the farm or district level, will cost relatively the same whether in the Sacramento Valley or around Bakersfield. This is because the cost of irrigation system hardware, skilled irrigation labor, or higher levels of management does not vary significantly throughout the state. What does vary is the associated reduction in losses. The percentage of applied water that results in recoverable and irrecoverable losses depends on the types of crops grown in a region, on-farm irrigation management, district water supply management and operation, hydrologic conditions, soils, and other physical and economic factors.

The cost to reduce losses, regardless of whether recoverable or irrecoverable, can be described in terms of dollars per acre-foot per year. This value would include the capital cost of any system improvements, amortized over the life of the system; and the increased costs of operation, maintenance, and management of the system—divided by the potential water savings (in acre-feet annually) that are anticipated to result from implementing the improvements. This value represents the cost to reduce total losses (irrecoverable and recoverable). **The cost associated with reductions in irrecoverable losses will be at least as great as that for overall loss reduction and in many cases, much greater, for reasons explained below.**

In areas where irrecoverable losses have been identified, each acre-foot of loss includes both recoverable and irrecoverable loss. The irrecoverable portion is generally a small percentage of the total, but in some cases it can approach 100%. The percentage will depend on the specific local conditions. Irrecoverable loss can be the result of either on-farm or district inefficiencies.

To illustrate this relationship, suppose a field is being irrigated at 75% **efficiency, defined as the ET of applied water and water needed to maintain salt balance and other cultural practices, divided by applied water**. In this case, 25% of applied water goes to losses. If losses (for example, surface runoff and percolation to degraded groundwater) are split evenly between recoverable and irrecoverable and if efficiency improvements equally reduce recoverable and irrecoverable losses, then a reduction by 1 acre-foot of applied water reduces irrecoverable loss by half that amount. Therefore, efficiency improvements that may cost $50 per acre-foot of overall loss reduction actually cost $100 per acre-foot of reduced irrecoverable loss.

Similarly, if irrecoverable loss accounts for only 20% of applied water savings, the actual (real) cost per acre-foot of conserving it would be five times greater, or $250 per acre-foot. The same example also could be made to describe this concept as it applies to district inefficiencies. However, in such an example, the field may be replaced with a set of delivery canals. Either way, some fraction of each acre-foot of loss is irrecoverable but not necessarily the entire acre-foot.

The analysis below uses a range of irrecoverable loss from 10 to 50% of total loss, based on estimates of existing on-farm conditions developed by Reclamation (DOI 1995). This translates to cost increases between 2 and 10 times the cost for applied water reduction.

4.10.2 ESTIMATED ON-FARM EFFICIENCY IMPROVEMENT COSTS

Cost estimates to increase on-farm efficiency are based on a study prepared for Reclamation "On-Farm Irrigation System Management" (CH2M HILL 1994). This study estimates the costs and performance characteristics of many different irrigation systems for eight crop categories common in the Central Valley. Costs are based on different combinations of hardware, operational regimes, and management and are expressed as dollars per acre per season. For a given crop, each irrigation system option is summarized by two main characteristics: the irrigation efficiency and the cost per acre per season.

For each crop, a nonlinear curve was fitted using each cost versus efficiency combination as a data point. The fitted curves describe the trade-offs between cost and irrigation efficiency. These curves have been incorporated into a regional agricultural production model called the Central Valley Production Model (CVPM). CVPM also incorporates data on cropping patterns, water use, and costs by region.

Using CVPM, estimates were made of the cost to improve average on-farm efficiency from current, or baseline, levels to 80%, then again to 85%. The model increases efficiency by 1% increments until the desired level is reached. The cost shown represents the cumulative cost to move from a baseline efficiency to an 85% level.

The values are presented on a per-acre-foot, per-year basis for regions in the Central Valley. Values for areas outside the Central Valley were extrapolated from the Central Valley data since the model is limited to the Central Valley. The cost shown in Table 4-18 represents the cost incurred for implementing and maintaining improved efficiency measures. In some cases, however, as a benefit of improved efficiency, a small discount may be subtracted from the values as a result of less water applied to the field (less water is purchased or pumped).

Table 4-18. Range of Annual Costs to Achieve On-Farm Efficiency of 85%

REGION	COST PER ACRE-FOOT OF APPLIED WATER REDUCED ($/af/yr)	IRRECOVERABLE LOSS IDENTIFIED (SEE TABLE 4-1)	COST PER ACRE-FOOT OF IRRECOVERABLE LOSS SAVED[1] ($/af/yr)
Sacramento	50-60	Yes	100-600
Delta	40-50	None identified	-
Westside San Joaquin River	35-45	Minimal	70-450
Eastside San Joaquin River	55-70	Minimal	110-700
Tulare Lake	75-95	Yes	150-950
San Francisco Bay	75-95[2]	Minimal	150-950[2]
Central Coast	75-95[2]	None identified	-
South Coast	75-95[2]	Yes	150-950[2]
Colorado River	–[3]	Yes	150-950[2]

[1] Costs shown for reducing irrecoverable losses are based on assuming from 10 to 50% of each acre-foot of applied water reduction is irrecoverable (i.e., costs are multiplied between 2 and 10 times the cost of applied water savings).

[2] These values have been extrapolated from the Tulare Lake Region results.

[3] The Colorado River Region has no water quality or ecosystem benefits that can be translated to the Bay-Delta as a result of applied water reductions. The only benefit is derived by reducing irrecoverable losses and transferring the water supply benefit to another entity dependent on Bay-Delta supplies.

This is only one of several economic benefits that may offset the cost of implementing improved irrigation. As discussed in the following two paragraphs, the cost can decrease or increase, depending on the situation.

Because water supply costs vary for each region, a beneficial savings that may be experienced from reducing applied water also will vary. Cost reductions also will depend on which supply of water is reduced, surface water or groundwater. If surface supplies are reduced, which are generally considered less expensive than groundwater, the savings benefit is lower. If groundwater pumping is reduced, the cost savings are usually greater. In general, reduced surface supply costs can offset the efficiency costs shown above by $2-$10 per acre-foot per year. Assuming a mix of reduced groundwater and surface supplies, this offset can be up to $10-$30, with the higher dollar savings occurring in areas with already higher per-acre-foot costs (for example, the Tulare Lake Region). These estimates assume that water supplies' fixed costs are held constant.

Although most water users will gain a minor savings from reduced water supply costs, some will see a minor increase. Increases will most likely be experienced by water users who currently depend on the losses of others to supply their needs. As these losses are reduced, so is their indirect water supply. To offset this reduction, these users will need to obtain water directly, either through groundwater pumping or direct delivery from a water supplier. In either case, the cost to obtain direct delivery of water is usually greater than the cost of indirect use.

4.10.3 ESTIMATED DISTRICT EFFICIENCY IMPROVEMENT COSTS

In addition to on-farm efficiency improvement costs to the growers as depicted in Table 4-18, districts or other local agencies may incur costs for on-farm improvements associated with necessary district or agency-level improvements. Without support by the water suppliers and other water agencies such as DWR and Reclamation, high on-farm efficiency, if not impossible, can be much more difficult to achieve. In addition, districts will incur significant costs for such district-level improvements as lining canals, flexible water delivery systems, regulatory reservoirs, and tailwater and spillwater recovery systems.

Estimates and projections of these costs for such improvements for different regions were made using information from local agencies, DWR, and Reclamation. Because of the unique situation at each water district, it is difficult to generalize about the costs. However, the estimates presented in Table 4-19 are intended to aid in the programmatic impact analysis. Costs shown for each region may vary for each specific project.

Table 4-19. Estimated District Efficiency Improvement Costs ($/yr)

REGION	COST TO SUPPORT ON-FARM EFFICIENCY IMPROVEMENTS[1]	COST FOR IMPROVEMENTS IN DISTRICT WATER DELIVERY[2]	TOTAL COST TO THE DISTRICTS	AVERAGE COST PER ACRE ($/af/yr)[4]
Sacramento	9,000,000	4,250,000	13,250,000	7.80
Delta	1,000,000	1,250,000	2,250,000	4.50
Westside San Joaquin River	4,000,000	1,080,000	5,080,000	11.80
Eastside San Joaquin River	6,000,000	3,180,000	9,180,000	7.25
Tulare Lake	13,000,000	8,000,000	21,000,000	6.60
San Francisco Bay	300,000	150,000	450,000	7.50
Central Coast	1,000,000	250,000	1,250,000	12.50
South Coast	1,000,000	none 3	1,000,000	3.30
Colorado River	3,000,000	1,630,000	4,630,000	7.10

[1] Improvements may include more district personnel, increased operation and maintenance costs, use of CIMIS stations, and hiring irrigation advisers. The cost will vary regionally because of the different crops and irrigation system mixes that are inherent in each region.

[2] Estimates are based on a $2.50 per-acre-foot, per-year cost for district-level activities such as improved delivery system monitoring and measurement, canal lining, system automation, and regional tailwater recovery systems. This cost is assumed to occur every year but may be higher in some years.

[3] No value is provided for the South Coast Region because most agriculture in this area is already served by pressurized municipal-type delivery systems. Additional improvement potential is limited.

[4] Average cost per acre is the total district cost divided by the average irrigated acreage in each region.